REQUEST FOR MMPA SECTION 120 PINNIPED REMOVAL AUTHORITY

APPLICATION

The Washington Department of Fish and Wildlife (WDFW), the Oregon Department of Fish and Wildlife (ODFW), and the Idaho Department of Fish and Game (IDFG) on behalf of their respective states (hereafter called "the States"), submit this application under Section 120(b)(1)(A) of the Marine Mammal Protection Act of 1972 (MMPA; 16 U.S.C. §1361 et seq.) to the National Marine Fisheries Service (NMFS) for the intentional lethal removal of California sea lions (*Zalophus californianus*) in the Columbia River which are having a significant negative impact on the recovery of Pacific salmon and steelhead (*Onchorynchus* spp.) listed as threatened and endangered under the Endangered Species Act of 1973 (ESA; 16 U.S.C. §1531 et seq.). Impacted salmon and steelhead include Lower Columbia River Chinook (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), Upper Columbia River Spring Chinook (endangered), Snake River spring/summer Chinook (threatened), Snake River Basin steelhead (threatened), Upper Willamette Chinook (threatened), and Upper Willamette Steelhead (threatened).

The States propose to lethally remove a limited number of California sea lions above Columbia River Navigation Marker 85 (approximate river mile 139.5), annually from January 1 to June 30. Any lethal removal activity will be preceded by a period of non-lethal deterrent activity (e.g., acoustic and tactile harassment), followed by an evaluation period. This incremental process (i.e., non-lethal deterrence followed by lethal removal and evaluation periods) will be repeated as necessary. In addition to animals located above Marker 85, all individually marked California sea lions that have been documented feeding on salmonids at Bonneville Dam would be candidates for removal without restriction to time or location in the river. Lethal removals in the first year of the proposed authorization is expected to be <1% of the Potential Biological Removal (PBR) level for California sea lions (current PBR level is 8,333 animals out of an estimated population of 237,000); the number to be removed in subsequent years is anticipated to be lower and would likely approach zero within several years. Individual sea lions would be lethally removed by humane methods following recommendations of Safety and Animal Care committees convened by the States. Carcasses would be used whenever possible for scientific or educational purposes.

No action, or continued use of non-lethal methods only, will likely result in an expansion of the problem by allowing increasing numbers of sea lions to become recruited into the pool of nuisance animals. The expected benefit of permanent removal of the animals in question will be to reduce a recent, unnatural, and significant source of mortality that has jeopardized the States' ongoing efforts to recover ESA-listed salmonids in the Columbia River Basin.

BACKGROUND

The States of Washington, Oregon, and Idaho have been involved in efforts to restore salmon and steelhead populations in the Columbia River Basin for decades. Despite these efforts, and those of countless other agencies and organizations, many populations remain threatened and endangered. In response, there has been an extraordinary and growing effort in this region to protect and recover salmonid populations. Recovery plans are being developed in every watershed to restore important habitat, improve dam passage survival, reform hatchery programs to assist wild populations, and reshape fisheries by focusing on selectively harvesting healthy hatchery fish. The people of the Northwest have supported restoration efforts, and borne the costs, because of the importance of salmon to our heritage, the cultural value to Native Americans, and the economic value of salmon to our fishing communities.

Against this backdrop, pinnipeds in the Pacific Northwest, under the protection of the MMPA, have enjoyed a marked recovery. Populations of Steller sea lions (*Eumetopias jubatus*), Pacific harbor seals (*Phoca vitulina*), and California sea lions have all increased significantly since the MMPA was passed (Jeffries et al. 2003, Brown et al. 2005, Carretta et al. 2006, Pitcher et al. in press). While there is no question that this has been a tremendous conservation success, negative interactions between growing pinniped populations with fishery resources and human activities have increased as a result (NMFS 1997, NMFS 1999).

One of the best documented pinniped-fishery conflicts occurred at the Ballard Locks in Seattle, Washington where a group of California sea lions had a significant negative impact on a winter steelhead run (Jeffries and Scordino 1997, Fraker and Mate 1999; also see Appendix 1 for chronology of events from 1980 to 1995). Under provisions of MMPA Section 109(h)(3), which allows non-lethal harassment of nuisance animals, WDFW and NMFS attempted to reduce predation using all available non-lethal options including underwater firecrackers, acoustic devices, taste aversion, barrier nets, and capture and relocation. Although naïve animals responded to some non-lethal techniques, predation by experienced individual sea lions was uncontrolled and annual predation losses increased.

In light of the situation at Ballard Locks, and at other areas along the Washington, Oregon and California coasts, Congress recognized the need for additional management options to reduce conflicts between protected pinnipeds and threatened and endangered salmonid fish stocks. In 1994 the MMPA was amended and Section 120 of the law was created to allow for lethal removal of pinnipeds in cases where they were having a negative impact on the decline or recovery of listed salmonid stocks.

In June 1994, pursuant to the amended MMPA's Section 120(b)(1)(C), WDFW applied to the Secretary of Commerce for authorization to lethally take California sea lions at the Ballard Locks. In January 1995, following convening of a Pinniped-Fishery Interaction Task Force, the Secretary of Commerce approved WDFW's request for authority to lethally remove sea lions with specific conditions. Over the next three years, WDFW complied with various additional non-lethal requirements of their Section 120 authorization added by the Pinniped-Fishery Interaction Task Force, ultimately capturing and transporting three individual sea lions identified

for lethal removal to Sea World in Orlando, Florida for permanent holding. During this three-year delay in removing selected individual sea lions, predation by California sea lions continued at the Ballard Locks; the Lake Washington winter steelhead run continued to decline, eventually reaching non-viable levels.

A limited number of California sea lions have again learned to exploit an artificial situation to disproportionately impact depressed salmonid runs, this time at Bonneville Dam on the Columbia River. In the last five years, over a hundred sea lions have learned to prey on spring runs of threatened and endangered adult salmonids as they attempt to pass through the dam's fish ladders. Many sea lions have been documented returning year after year. Over the past four years, an average of nearly 3,000 salmonids per year has been consumed in the tailrace of the dam alone. And as was the case at Ballard Locks, attempts at non-lethal deterrence have been largely unsuccessful.

The States' contend that recent losses to California sea lions, which are known to represent the minimum amount of California sea lion predation in the river, represent a significant negative impact on the recovery of ESA-listed Columbia River salmonids because: 1) it is a new, growing, and unmanageable source of mortality, while other sources of in-river mortality are actively managed and are stable or decreasing (e.g., through harvest reductions, fish passage and habitat improvements, and hatchery reform); and 2) the hydromodification of the river has altered the natural predator-prey relationship to artificially favor predatory California sea lions. It is not the States' contention that California sea lion predation is more significant than other sources of mortality to Columbia River ESA-listed salmonids, but simply that it is significant and that it must be dealt with as are other sources of mortality.

It is vitally important to restore a balance in the Columbia River between the abundant California sea lion population and the endangered and threatened salmon and steelhead populations. In areas where salmonids are vulnerable, the States' need to use every available wildlife management tool to restore that balance including the authority to remove animals when feasible and prudent non-lethal efforts fail to change a sea lion's behavior. The MMPA was amended precisely to deal with situations such as the one that has arisen at Bonneville Dam and we urge the Secretary to approve this Section 120 request.

Sec. 120(d)—APPLICATION CONSIDERATIONS

Sec. 120(d)(1)—Pinniped population trends, feeding habits, and interaction description

Status and trends of California sea lions

The MMPA was passed in recognition that many marine mammal populations were depleted and that they should be protected until they again became a significant functioning element of the ecosystem. In the case of pinnipeds in the Pacific Northwest, protection provided under the MMPA has been a huge success. Populations of Steller sea lions (*Eumetopias jubatus*), Pacific harbor seals (*Phoca vitulina*), and California sea lions have all increased since the MMPA was passed (Jeffries et al. 2003, Brown et al. 2005, Carretta et al. 2006, Pitcher et al. in press).

Currently, the U.S. stock of California sea lions is not listed as: 1) “threatened” or “endangered” under the ESA; 2) "depleted" under the MMPA; or 3) considered a "strategic" stock (Carretta et al. 2006). The population has been growing recently at 5.4% to 6.1% per year and is estimated to number approximately 237,000 animals (though some analyses suggest the population may be closer to 300,000). The Potential Biological Removal (PBR) level, which is the sustainable level of human caused mortality allowed under the MMPA and subsequent regulations, is 8,333 animals per year. Current estimates of human caused mortality, primarily due to incidental take in commercial fishery operations, averaged 1,476 animals per year from 1997 to 2001 (Carretta et al. 2006).

California Sea Lions in the Columbia River Basin

California sea lions occur seasonally in the Pacific Northwest, migrating northward each fall from their breeding grounds in southern California and Mexico in search of foraging areas, returning to their southern breeding areas again the following summer. With the exception of a few females, all California sea lions in the Pacific Northwest are subadult or adult males. It is from fall through spring when California sea lions are present in the lower Columbia River Basin, with most animals being found in upriver areas from January through May.

Throughout the first half of the 20th century, California sea lions were not common in the Columbia River. Steller sea lions were the dominant sea lion species in the Pacific Northwest and harbor seals were the most commonly observed pinniped in the lower Columbia River. Prior to enactment of the MMPA in 1972, Oregon and Washington had bounties in place in an effort to keep pinniped populations low. In addition, a seal hunter was employed to drive pinnipeds out of the Columbia River until 1970. By the mid-1970s observations of California sea lions in the Pacific Northwest began to increase, but they were still relatively uncommon in the lower Columbia River until the mid- to late-1980s (Beach et al. 1985). By the early 1990s, several hundred California sea lions were regularly found in the Astoria area, hauling out on jetties, floats, and navigation markers (WDFW, ODFW, unpublished data). At that time, sea lions were foraging in the lower river to near Wallace Island (river mile 48), often targeting salmon caught

in nets during commercial gillnet fishing seasons. However, these sea lions also began to forage farther upriver in search of prey, including anadromous smelt or eulachon (*Thaleichthys pacificus*) that returned to tributaries such as the Cowlitz River (river mile 70). In the mid-1990s observations of California sea lions in the Willamette River and Willamette Falls (128 miles upstream form the mouth of the Columbia) began to increase. By the late 1990's roughly a dozen sea lions were regularly found foraging for winter steelhead and spring Chinook (both ESA-listed species) below the fishways at Willamette Falls. More recently, California sea lions have been observed feeding on salmonids in the Lewis, Kalama, and Cowlitz Rivers.

In 2000, observations of California sea lions at Bonneville Dam on the mainstem Columbia River (river mile 146) began to increase. Prior to that year, this species was rarely observed this far from the Pacific Ocean with only one or two animals being seen each spring since the 1980s. In 2001, up to six sea lions were reported foraging for salmonids near fishways at Bonneville Dam. By 2002 it was estimated by the U.S. Army Corps of Engineers (ACOE) that 30 sea lions were foraging for salmonids from January through May; in subsequent years numbers increased to approximately 100 individuals (Table 1). On several occasions, California sea lions have been known to move above Bonneville Dam by swimming into the lock before the lower gate had been closed and/or by riding on barges or other vessels passing through the lock system.

Table 1. Annual summaries of pinniped abundance and duration at the Bonneville Dam tailrace from 2002-2006 (sources: Stansell 2004, ACOE, unpublished data).

	2002	2003	2004	2005	2006
Total number of individual pinnipeds	31	111	105	85	85
California sea lions	30	106	101	80	72
Steller sea lion	0	3	2	4	10
Harbor seals	1	2	2	1	3
Maximum daily number of pinnipeds	14	32	37	43	46
Maximum number of days individual was present	14	25	31	39	72
Date of first pinniped sighting	3/20	3/14	2/24	2/10	2/9
Date of last pinniped sighting	5/17	5/24	5/26	6/10	6/5
Total number of days pinnipeds present	59	72	93	121	117

While Steller sea lions and Pacific harbor seals occasionally occur near Bonneville Dam, they are currently not considered a significant source of mortality to ESA-listed salmonids due to their small numbers and favorable response to deterrence in the case of Steller sea lions.

California sea lion feeding habits

California sea lions are opportunistic predators that feed on a wide variety of fish and squid. Their diet is diverse and varies seasonally by location. Some of the common prey within their breeding range in California waters are Pacific whiting, anchovy, market squid and shortbelly

rockfish (Scheffer and Neff 1948, Fiscus and Baines 1966, Fiscus 1979, Antonelis et al. 1984). In Washington and Oregon, their diet consists primarily of seasonally abundant schooling species such Pacific whiting, herring, Pacific mackeral, eulachon, salmon and squid as well as Pacific lamprey, codfish, walleye pollock, and spiny dogfish (Appendix 2). Movements and distribution of California sea lions are often correlated with spawning aggregations of various prey (e.g., Pacific whiting, herring, salmonids) and indicate the ability of California sea lions to cue into locally abundant concentrations of these species (NMFS 1997). While California sea lions at Bonneville Dam have been documented eating lamprey, shad, northern pikeminnow, and most recently sturgeon, these prey items are incidental to their primary prey at the dam which are salmon and steelhead (Table 2; also see Stansell 2004).

Table 2. Percent frequency of occurrence (FO) of prey items identified in scat (n=20) collected from a haul-out used by California sea lions near Powerhouse-2 at Bonneville Dam, May 4-6, 2006.

Prey item	Frequency of occurrence (%)
Adult salmonids	95[1, 2]
Lamprey species	40
Juvenile salmonids	25
Unidentified (probably salmonid and pikeminnow)	10
Clupeidae species (probably American shad)	5
Gadidae species (probably Pacific tomcod)	5

[1] The single scat without identifiable salmonid remains contained ribs that were most likely from a salmonid. If so then salmonid FO would be 100%.

[2] A PIT tag was found in a scat collected on May 4. The PIT tag (3D9.1BF112523A) was from an adult Chinook of unknown run or rear type. The Chinook was PIT and radio tagged on 4/18/06 in the Bonneville fish ladder and re-released downstream by Idaho Cooperative Fish and Wildlife Research Unit as part of their research on the effects of non-lethal sea lion deterrent activities on salmonids.

Identification of individual predatory sea lions

All California sea lions above Navigation Marker 85 forage for salmonids and as such are "identifiable" (i.e., in the sense that it is not possible to confuse them with individuals that don't eat salmonids), and therefore candidates for lethal removal. While it is therefore not necessary to uniquely identify individual animals, it is possible to do so for some individuals, based either on natural markings or brands.

Branding of California sea lions in the Columbia River began in 1997, as numbers of California sea lions foraging for salmonids in upriver areas continued to increase (e.g. at Willamette Falls). ODFW (with support from NMFS and WDFW) began a California sea lion capture and marking operation near the mouth of the Columbia River at Astoria, Oregon. The goal of this project was to apply permanent, individually identifiable marks to California sea lions using the Columbia in order to: 1) observe the movements and activities of individual sea lions in the river; 2) describe

foraging patterns of individual animals; and 3) to document the recurrence of individual sea lions at specific foraging areas from year to year.

From 1997 through fall 2006, nearly 1,000 California sea lions had been captured at the Astoria trap, 621 of which were permanently and uniquely marked with "C" brands. Of those 621, forty-seven (7.5%) have been observed foraging for salmonids in the area immediately below Bonneville Dam. Four other California sea lions branded at other locations (Puget Sound, WA and San Miguel Island, CA) have also been observed below Bonneville Dam, for a minimum of 51 permanently marked sea lions observed at the dam (see Appendix 3 for a list of marked sea lions observed at Bonneville Dam from 2002-2006). An additional eight individually marked California sea lions have been observed feeding on salmonids in the area below Willamette Falls, two of which have been observed at Bonneville Dam as well (C235, C257).

In 2005, one marked sea lion (C404) had found his way into one of the Powerhouse-2 fish ladders at Bonneville Dam. This animal moved up the fish ladder while foraging for salmonids to the point where it was visible in one of the fish counting and viewing windows in the facilities visitor center. This animal repeatedly entered the fish ladder and was successful at capturing salmonids in the lower reaches of the fishway. ACOE personnel used various hazing tools to deter this animal with very limited success. Ultimately, ACOE installed sea lion exclusion devices (SLEDs) in the openings of the fishways at a cost of one million dollars in an attempt to keep sea lions out. In 2006, C404 returned and immediately squeezed through the SLED to again consume salmon in the fish ladder.

Sec. 120(d)(2)—Nonlethal deterrence efforts

Existing nonlethal deterrent methods

Non-lethal methods to deter pinnipeds from feeding on fish or using specific areas include a variety of harassment measures, aversive conditioning, exclusion, and removal. These are described in NMFS (1997), Fraker and Mate (1999), and Bowen (2004) and are briefly summarized below. Most of these methods were developed, tested or considered during the Ballard Locks experience (see Appendix 1). Unfortunately, efforts at finding an effective, long-term solution to eliminating or reducing predation on salmonids have proven unsuccessful. While in some cases its been found that deterrents can be effective on "new" or naïve animals, the same methods become ineffective over time or when used in the presence of experienced animals that did not react to deterrents (NMFS 1996).

Acoustic harassment.—Acoustic sources used to deter pinnipeds include Acoustic Harassment Devices (AHDs), Acoustic Deterrent Devices (ADDs), underwater firecrackers ("seal bombs"), cracker shells (shotgun shells with an explosive projectile), and the underwater playback of predator sounds. While in some cases these methods have limited success, the relatively rapid habituation, or evasion of exposure to stimuli, typically results in no long term reduction in pinniped numbers (e.g., Anderson and Hawkins 1978, Beach et al. 1985, Gearin et al. 1986, Pfiefer et al. 1989, Geiger and Jeffries 1986).

Tactile harassment.—Tactile harassment of pinnipeds has involved the use of blunt-tipped arrows and rubber projectiles discharged from a shotgun. Both methods have met with limited or no success (Pfeifer et al. 1989, ODFW unpublished data).

Vessel chase.—California sea lions were chased by boats at the Ballard Locks but animals learned to avoid vessels or swim under them (Pfeifer et al. 1989).

Aversive conditioning.—Dead steelhead treated with an emetic were give to California sea lions at Ballard Locks. All individuals refused a second treatment and had resumed normal predation within a week of initial treatment (Pfeifer 1988).

Exclusion.—While physical barriers can be effective at keeping animals out of very small areas (i.e., entrances to fish ladders), in large areas they are expensive to build and maintain, and can have a negative effect on the fish species they are meant to help.

Capture, relocation, and captivity.—Capture and relocation of pinnipeds to another part of their range had been attempted with limited success with harbor seals (Olesiuk et al. 1995), California sea lions (Jeffries and Scordino 1997), and northern elephant seals (Oliver et al. 1998,). Most animals return within a short period of time due to pronounced homing ability and site fidelity, and avoid subsequent recapture. Furthermore, not all animals can be captured and relocation over great distances raises concerns over parasite or disease transmission. Temporary or permanent captivity is not a practical long-term solution given the cost of care, feeding, and housing many dozens of animals (assuming they could be caught). Furthermore, temporary holding may habituate animals to humans resulting in other problems after release (lack of fear, overt aggression, and food dependency).

Nonlethal deterrent efforts at Bonneville Dam

Despite the proven lack of success associated with nonlethal deterrents, WDFW, ODFW, ACOE, NMFS, and Columbia River Inter-Tribal Fish Commission (CRITFC) met in 2004 to discuss nonlethal deterrent actions to stop sea lions from taking salmonids at Bonneville Dam. Under MMPA Section 109(h)(1)(C), the ACOE, NMFS, WDFW and ODFW have similar authorities to take non-listed nuisance pinnipeds. At the initial meeting it was decided that the four state/federal agencies would work jointly under the MMPA authorities to conduct preliminary tests of the available non-lethal methods to: 1) deter and exclude sea lions from the fish passage facility; and 2) to deter nuisance sea lions from the tailrace at Bonneville Dam to protect returning adult fish waiting to move through the fishway. Preliminary tests were conducted in 2005 followed by a more intensive experiment in 2006.

2005 nonlethal deterrence efforts

Test One was conducted on May 5 and 6, 2005 and included use of noise stimuli (firecrackers, cracker shells and rockets), boat hazing and chasing. Test Two was conducted from shore on

May 17 and 18, and included tactile harassment (rubber sabot rounds and rubber buckshot). The tests were conducted in the tailrace area primarily below Powerhouse-1 (PH1) on the Oregon side, Powerhouse-2 (PH2) on the Washington side, and in the Boat Restricted Zone (BRZ) below Bonneville Dam. The tailrace below the spillway portion of the dam was determined to be too hazardous for personnel to work from boats during the initial test period. Shore based hazing was attempted in the spillway area during the second test.

Sea lion presence was well established at Bonneville Dam prior to the beginning of any attempts to protect returning fish via non-lethal deterrence. Approximately 85 animals had been seen at the facility prior to the start of May and at no time during the hazing activities were sea lions completely absent from the tailrace. In general, sea lion attendance ranged from a low of 8 to a high of 27 animals per hour in the tailrace during periods when hazing activities were not being conducted (May 4 – 7 and May 16 – 19).

When active hazing was conducted, sea lion attendance dropped in areas where activity was concentrated. During Test One, sea lion presence at PH2 dropped from an average of 9 animals per hour to zero on the first day of hazing from boats. On the second day of hazing, sea lion presence at PH1 and PH2 dropped from an average of 11 and 9 animals per hour respectively, before active hazing, to an average of 2 and 1 animals per hour respectively once refugia were established. During Test Two, sea lion attendance at PH1 and PH2 dropped from 9 and 11 animals per hour at the start of hazing from shore to 1 to 2 animals per hour during hazing on the first day. The next day the sea lions responded more quickly to shore based hazing and attendance dropped to 1 to 2 animals at PH1 and PH2 from 3 to 4 animals per hour prior to active hazing.

Sea lions returned to the treatment areas within a few hours after hazing stopped. On the first day of Test One, overall sea lion abundance changed little during the day (19 before, 17 during and 20 after hazing) but attendance shifted away from PH2 where hazing was concentrated. On the second day of Test One, overall sea lion abundance dropped in half during hazing and increased once hazing ended. During Test Two a similar pattern was seen (i.e., variations in abundance and shifts in attendance during hazing activities). Boat surveys in the area below the tailrace, conducted before and after hazing each day during Test Two, indicated that some sea lions moved downstream during hazing and then returned to the dam once hazing stopped.

Predation increased in areas where sea lions moved in response to hazing. Predation dropped in areas abandoned by sea lions during hazing. On the first day of Test One, sea lions vacated PH2 and numbers increased at PH1 and the spillway along with an increase in observed predation. Similarly on the second day, the majority of predation observed during hazing occurred at the spillway where hazing was not done. A similar pattern was seen during Test Two. It was not possible to determine any individual or residual effect on predation efficiency, by sea lions subjected to harassment.

2006 nonlethal deterrence efforts

The ACOE conducted a controlled hazing experiment at Bonneville Dam from March 5 to May 27, 2006. Sea lions were hazed using acoustic harassment devices mounted below the dam and

pyrotechnics (i.e., cracker shells) fired from the deck of the dam. Hazing occurred during randomly chosen two-day periods within 21 consecutive four-day blocks (resulting in 42 days of deck-based hazing across 84 days). Before, during, and after the hazing experiment (Feb 6 to June 2), observers quantified the number of salmonids predated by sea lions in the vicinity of the dam in order to quantify total seasonal predation and assess effects of the hazing treatment.

Beginning April 2, WDFW and ODFW (with assistance from Oregon State Police (OSP), CRITFC, Pacific States Marine Fisheries Commission (PSMFC), and NMFS, initiated boat-based hazing on a systematic four-days on, four-days off schedule such that every four-day period would overlap with the ACOE's hazing blocks. Boat-based hazers used a combination of seal bombs, cracker shells, rubber buckshot, and vessel chase in an attempt to deter pinnipeds from the area immediately below the dam to approximately seven river miles downriver. This work continued through May 23. Boat-based hazing efforts occurred over a total of 28 days. One to three boats were employed per day (average = 2) with one to four people per boat (average = 2), resulting in approximately 112 person-days of effort. Hazing was conducted for approximately six hours per day (0900-1500).

Results indicate that neither the ACOE hazing (using acoustics and dam-based pyrotechnics), nor the WDFW/ODFW hazing (using boat-based pyrotechnics) reduced the number of salmonids consumed by sea lions (Fig. 1). An estimated 1,000 boat-based hazing "engagements" occurred (where an engagement was defined as actively hazing one or more individual sea lions). Based on a tally of over 400 recorded engagements, approximately 50% of the hazed animals responded by moving downriver, 10% moved upriver, and response of the remaining 40% could not be determined (e.g., they submerged and were not relocated). Downriver movements by hazed animals appeared to be temporary as there was no long-term decrease in the number of pinnipeds or predation due to hazing.

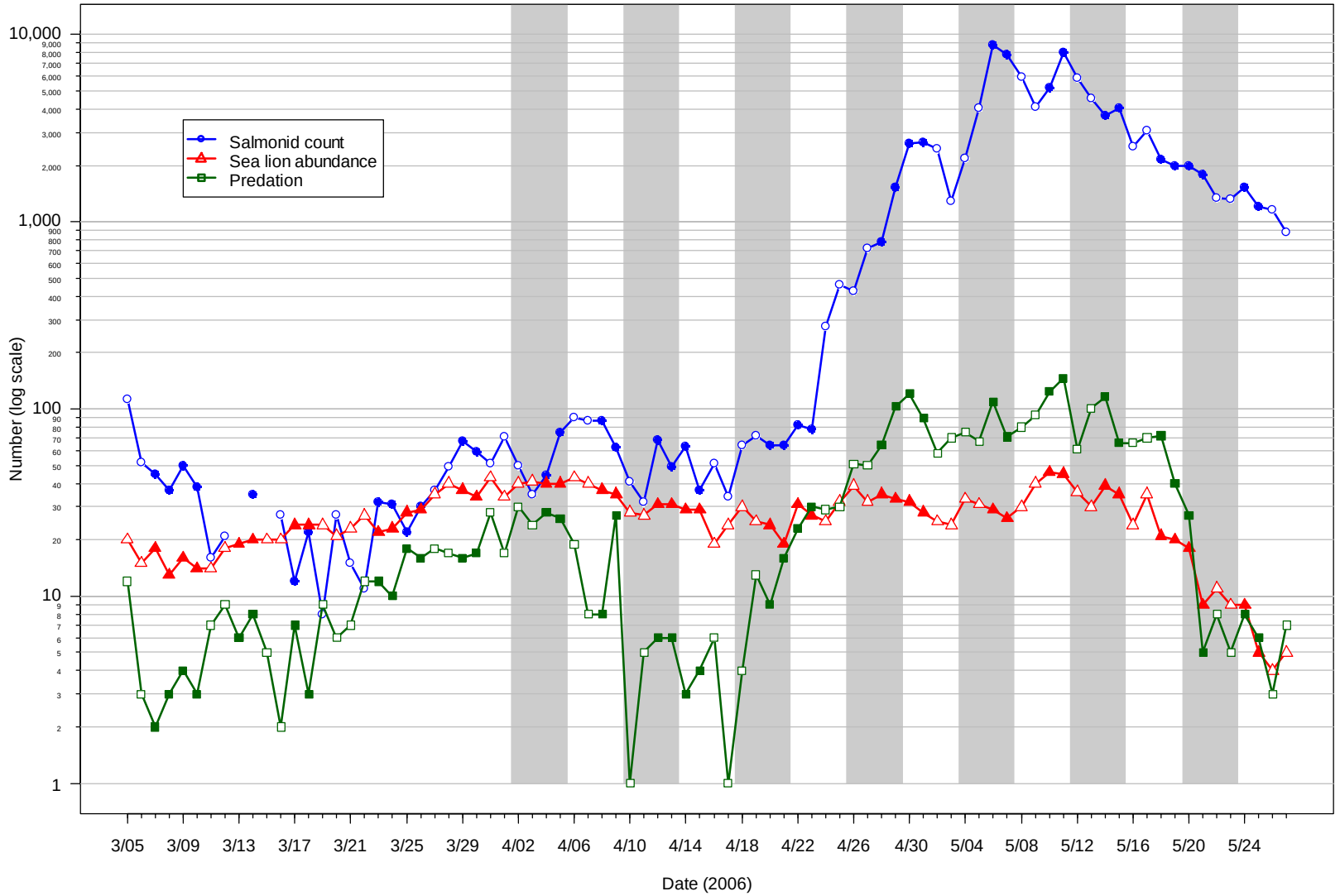

Figure 1. Preliminary results of 2006 non-lethal deterrence experiments at Bonneville Dam (source: ACOE, unpublished data). Solid circles (salmonid count), triangles (sea lion abundance), and squares (predation) indicate days on which ACOE deterrent treatments occurred; vertical gray bars indicate days on which ODFW/WDFW deterrent treatments occurred.

Sec. 120(d)(3)—Impact on fish populations

Status of salmon and steelhead in the Columbia River Basin

Currently there are eight Evolutionary Significant Units (ESUs) of salmon and five Distinct Population Segments (DPS) of steelhead in the Columbia River Basin listed under the ESA[1] (Table 3; NMFS 2005, 2006; http://www.nwr.noaa.gov/ESA-Salmon-Listings/). Of these, eight are potentially subject to predation by California sea lions (and other pinnipeds) in the mainstem Columbia River and its tributaries (e.g., Willamette River, Lewis River, Kalama River), and six are potentially subject to predation as they attempt to pass above Bonneville Dam.

Table 3. Status and potential exposure of ESA-listed Columbia River salmonids to California sea lion predation.

		Potentially impacted by CA sea lions (Jan 1 – June 30)	
ESA-listed Columbia River salmonids	Status*	Mainstem & tributaries	Bonneville Dam
Upper Willamette R. Chinook	T	X	
Upper Willamette R. Steelhead	T	X	
Columbia R. Chum	T		
Lower Columbia R. Coho	T		
Lower Columbia R. Chinook	T	X	X
Lower Columbia R. Steelhead	T	X	X
Mid-Columbia R. Steelhead	T	X	X
Upper Columbia R. Spring Chinook	E	X	X
Upper Columbia R. Steelhead	T		
Snake R. Spring/Summer Chinook	T	X	X
Snake R. Steelhead	T	X	X
Snake R. Fall Chinook	T		
Snake R. Sockeye	E		

* T = threatened, E = endangered.

All of the Columbia River ESUs/DPSs have declined significantly from their historic abundance. For example, Chapman (1986) estimated that the Columbia River produced 2.5-3.0 million

[1] The ESA defines a "species" to include any distinct population segment of any species of vertebrate fish or wildlife. For Pacific salmon, NOAA Fisheries considers an Evolutionarily Significant Unit, or "ESU," a "species" under the ESA. For Pacific steelhead, NOAA Fisheries has delineated Distinct Population Segments (DPSs) for consideration as "species" under the ESA.

spring and summer Chinook in the late 1880s. Total spring and summer Chinook production from the Snake River Basin contributed a substantial portion of those returns; the total annual production of Snake River spring and summer Chinook may have been in excess 1.5 million returns per year (Mathews and Waples 1991). In comparison, the 1997-2001 average spring/summer Chinook natural adult return to the Snake Basin was estimated at less then 10,000 adults.

There are multiple populations within each ESU/ DPS at various levels of risk of extirpation. There is currently a listed salmon or steelhead population in every sub-basin of the Columbia River. The salmon and steelhead returning to areas of the Columbia River Basin upstream of Bonneville Dam are subject to migration delays and increased marine mammal predation at Bonneville Dam. In addition, the salmon and steelhead originating below Bonneville Dam are subject to marine mammal predation in the mainstem migration corridor, as well as increased level of predation resulting from sea lions entering the various tributaries in the lower Columbia River (e.g., Cowlitz, Kalama, Lewis, and Willamette Rivers). Status of individual populations within ESUs/DPSs subjected to sea lion predation during winter and spring in the Columbia River is variable, with some populations already extirpated and the remaining populations at variable risks of extirpation (Appendix 4).

Predation impact at Bonneville Dam

In 2002 the ACOE Fisheries Field Unit began a research effort to determine when pinniped predation occurs in the Bonneville Dam tailrace, numbers of pinnipeds present, numbers of individuals observed, numbers of salmonids consumed, and the proportion of all salmonids passing Bonneville that are taken by pinnipeds foraging in the tailrace of the dam. Information from that study, which has continued through 2006, is summarized in Table 4.

Table 4. Annual summaries of salmonid abundance[1] and estimated take by sea lions at Bonneville Dam 2002-2006 (sources: Stansell 2004, ACOE, unpublished data).

	2002	2003	2004	2005	2006
Salmonid abundance[1]	284,733	217,185	186,804	82,006	105,063
Estimated take	1,010	2,329	3,533	2,920	3,023
% of run taken[2]	0.35%	1.06%	1.86%	3.44%	2.80%

[1] Combined Chinook and steelhead abundance passing Bonneville Dam during ACOE study periods.
[2] =Estimated take/(estimated take + salmonid abundance).

It is important to note that estimates of loss at Bonneville Dam are minimum estimates because they apply only to the area immediately below the dam (<0.5 mi). California sea lions, however, have been documented feeding on salmonids immediately below Bonneville Dam to Navigation Marker 85 (WDFW, ODFW, unpublished data), as well as throughout the lower Columbia River. In addition, there is an unknown amount of delayed mortality caused by injury to fish that escape predation. Pinniped predation estimates at the dam therefore represent a minimum lower bound on total river-wide predation. Preliminary bioenergetic modeling, for example, suggests that

California sea lions could be consuming 13,000 salmon each spring (based on 100 sea lions consuming a 100% diet of 8 kg salmon for 100 days).

The States' contend that recent losses to California sea lions, which are known to represent the minimum amount of California sea lion predation in the river, represent a significant negative impact on the recovery of ESA-listed Columbia River salmonids because: 1) it is a new, growing, and unmanageable source of mortality, while other sources of in-river mortality are actively managed and are stable or decreasing (e.g., through harvest reductions, fish passage and habitat improvements, and hatchery reform); and 2) the hydromodification of the river has altered the natural predator-prey relationship to artificially favor predatory California sea lions. It is not the States' contention that California sea lion predation is more significant than other sources of mortality to Columbia River ESA-listed salmonids, but simply that it is significant and that it must be dealt with as are other sources of mortality.

Addressing predation as part of a comprehensive fish recovery strategy

Significant actions to address the decline of salmon populations in the Columbia River basin have been underway for several decades and are progressing each year as a result of development and implementation of ESA conservation and recovery plans through out the basin. These actions include harvest reductions, hydroelectric system mitigation, watershed and subbasin planning, and hatchery reform.

Harvest reductions.—Harvest reductions have occurred each decade since the 1940s and have been further reduced since ESA listings. Harvest management plans, which are ordered through the federal court in the *U.S. v. Oregon* case, limit Indian and non-Indian impacts to ESA-listed fish. The *U.S. v. Oregon* management agreements include conservation and rebuilding objectives for Columbia River natural populations. Harvest strategies are designed to harvest healthy populations and hatchery fish while minimizing or avoiding incidental impacts to listed natural populations. The winter and spring sport and commercial fisheries below Bonneville Dam are selective for marked hatchery fish and must release wild fish unharmed. Harvest of healthy stocks has been reduced significantly in order to protect ESA-listed fish, resulting in major economic consequences for commercial and sport fishing industries as well as reductions in harvest opportunities associated with Treaty Indian fishing rights.

Hydroelectric system mitigation.—Hydroelectric system mitigation was initially focused on producing hatchery fish to replace lost natural fish production, but in recent years mitigation efforts have also focused on operations, configuration, and management of the basin water supply to improve survival of natural salmon and steelhead. The Federal Columbia River Power System plan for recovery of natural populations has been remanded through a federal court order and is being re-developed through a collaborative process and is linked to a full recovery planning process for all the sources of impacts in the Columbia basin.

Watershed and subbasin planning.—Watershed and subbasin plans are completed or under development through out the Columbia basin. These plans form the basis for implementation of tributary and estuary habitat improvements to be funded through various federal salmon

restoration funding mechanisms, most notably the Columbia Basin Fish and Wildlife Program, (administered through the Northwest Power Act and funded by the Bonneville Power Administration), and the Salmon Recovery Fund (supported by Congressional appropriations). Additionally state, Federal and private forest management plans are aimed at improving freshwater habitat for fish. Many local jurisdictions have supported recovery actions outlined in local recovery plans and have committed to implementation of associated land use laws under their jurisdiction.

Hatchery reform.—Hatchery reform is underway to assure that hatchery programs either assist in the recovery of natural populations or mitigation hatchery programs do not impede progress towards recovery. A complete review of hatchery programs and reform options to meet the needs of natural fish has commenced through a congressional sponsored review process. There is also a review through the ESA permitting process that has either been completed or is on-going in consultation between the hatchery operators and NMFS.

The above investments are being made to improve survival of the ESA-listed salmon and steelhead in the Columbia Basin and will continue to increase significantly as comprehensive recovery plans, which involve all sources of human impacts to salmon, are implemented. Despite all of these efforts, however, Columbia River salmon and steelhead are still in danger of extinction. California sea lions are at high levels of abundance in the river and their increasing predation rates represent a mounting threat to the recovery of listed stocks. All threats to recovery must be appropriately minimized including California sea lion predation on salmon and steelhead at Bonneville Dam.

Sec. 120(d)(4)—Threats to public safety

Commercial salmon gillnet fisheries in the Columbia River have encountered problems with harbor seals damaging gear and catch for many years. Similar problems with California sea lions have increased with growing numbers of these animals in the river through the 1990s. Most recently, negative interactions between sport anglers and California sea lions in many areas of the Columbia River and some tributaries has become a serious problem. California sea lions often exhibit bold and aggressive behaviors that include stealing hooked fish while they are being landed, even to the point of taking the fish from a landing net or the hands of an angler bringing the fish into the boat. There have been reports of anglers being bitten by sea lions in this situation as well as anglers being pulled overboard while holding onto a landing net that was grabbed by a sea lion. Many sport angling vessels are small and could be capsized by these types of actions by sea lions taking hooked or netted fish from anglers close to the boat.

LITERATURE CITED

Anderson, S. A., and A. D. Hawkins. 1978. Scaring seals by sound. Mammal Review 8:1924.

Antonelis, G. A. Jr., C. H. Fiscus, and R. L. DeLong. 1984. Spring and summer prey of California sea lions, *Zalophus californianus*, at San Miguel Island, California, 1978-79. Fishery Bulletin 82:67-76.

Beach, R. J., A. C. Geiger, S. J. Jeffries, S. D. Treacy, and B. L. Troutman. 1985. Marine mammals and their interactions with fisheries of the Columbia River and adjacent waters, 1980-1982. NMFS-AFSC Processed Report 8504. 316 p.

Bowen, W. D. 2004. Report of the seal exclusion zone workshop. DFO Canadian Science Advisory Secretariat Proceedings Series 2004/022.

Brown, R. F., B. E. Wright, S. D. Riemer, and J. Laake. 2005. Trends in abundance and status of harbor seals in Oregon: 1977-2003. Marine Mammal Science 21:657-670.

Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M. Lowry. 2006. U.S. Pacific Marine Mammal Stock Assessments: 2005. NOAA Technical Memorandum NMFS-SWFSC-388. 317p.

Chapman, D.W. 1986. Salmon and steelhead abundance in the Columbia River in the nineteenth century. Transactions of the American Fisheries Society 115: 662–670.

Fiscus, C. 1979. Interactions of marine mammals and Pacific hake. Marine Fisheries Review 41(10):19.

Fiscus, C.H., and G.A. Baines. 1966. Food and feeding behavior of stellar and California sea lions. Journal of Mammaology 47(2):195-200.

Fraker, M. A., and B. R. Mate. 1999. Seals, sea lions, and salmon in the Pacific Northwest. Pages 156-178 *in* J. R. Twiss Jr. and R. R. Reeves, editors. Conservation and management of marine mammals. Smithsonian Institution Press, Washington, D.C., USA.

Gearin, P., R. Pfeifer, and S. Jeffries. 1986. Control of California sea lion predation of winterrun steelhead at the Hiram M. Chittenden Locks, Seattle, December 1985-April 1986. Washington Department of Fish and Wildlife, Fishery Management Report 8620. 108 p.

Jeffries, S. J., and J. Scordino. 1997. Efforts to protect a winter steelhead run from California sea lions at the Ballard Locks. Pages 107-115 *in* G. Stone, J. Goebel, and S. Webster, editors. Pinniped populations, eastern north Pacific: status, trends, and issues. New England Aquarium, Boston, MA and Monterey Bay Aquarium, Monterey, CA, USA.

Jeffries, S., H. Huber, J. Calambokidis, and J. Laake. 2003. Trends and status of harbor seals in Washington state: 1978-1999. Journal of Wildlife Management 67:207-218.

National Marine Fisheries Service (NMFS). 1996. Environmental assessment on conditions for lethal removal of California sea lions at the Ballard Locks to protect winter steelhead. NMFS Environmental Assessment Report. 81 p.

National Marine Fisheries Service (NMFS). 1997. Investigation of scientific information on the impacts of California sea lions and Pacific harbor seals on salmonids and on the coastal ecosystems of Washington, Oregon, and California. NOAA Technical Memorandum. NMFS-NWFSC-28.

National Marine Fisheries Service (NMFS). 1999. Report to Congress: Impacts of California sea lions and Pacific harbor seals on salmonids and West coast ecosystems. National Marine Fisheries Service.

National Marine Fisheries Service (NMFS). 2005. Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs. Federal Register 70:37160.

National Marine Fisheries Service (NMFS). 2006. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead; Final Rule. Federal Register 71:834.

Olesiuk, P. F., G. H. Horonowitsch, G. M. Ellis, L. Flostrand, and S. C. Warby. 1995. An assessment of harbour seal (*Phoca vitulina*) predation on outmigrating chum fry (*Oncorhynchus keta*) and coho smolts (O. kisutch) in the lower Puntledge River, British Columbia. PSARC Working Paper S95-10.

Oliver, G. W., P. A. Morris, P. H. Thorson, and B. J. Le Boeuf. 1998. Homing behaviour of juvenile northern elephant seals. Marine Mammal Science. 14:245-256.

Pitcher, K. W., P. F. Olesiuk, R. F. Brown, M. S. Lowry, S. J. Jeffries, J. L. Sease, W. L. Perryman and C. E. Stinchcomb. *In press*. Status and trends in abundance and distribution of the eastern Steller sea lion (Eumetopias jubatus) population. Fishery Bulletin.

Pfeifer, R. P. 1988. Lake Washington winter-run steelhead/marine mammal interactions. Problem history, past procedures used, and a discussion of possible control options. Washington Department of Fish and Wildlife Report.

Pfeifer, R., P. Gearin, S. Jeffries, M. Johnson, and R. DeLong. 1989. Evaluation of the 1987-88 California sea lion predation control program in the Lake Washington estuary. Washington Department of Fish and Wildlife, Fishery Management Report 899. 216 p.

Scheffer, V.B. and J.A. Neff. 1948. Food of California sea lions. Journal of Mammalogy 29(1):67-68.

Scordino, J. 1993. Review and evaluation of pinniped predation on salmonids in the Columbia River Basin. National Marine Fisheries Service, Northwest Region. 34 p.

Stansell, R. J. 2004. Evaluation of pinniped predation on adult salmonids and other fish in the Bonneville Dam tailrace, 2002-2004. U.S. Army Corps of Engineers, CENWP-OP-SRF, Bonneville Lock and Dam, Cascade Locks, OR 97014.

Appendix 1. Chronology of efforts to address the sea lion/steelhead conflict at the Ballard Locks, Seattle, Washington.

1980-84
California sea lion predation on steelhead at the Locks first noticed by the public in 1980. First use of firecrackers by State agents to harass sea lions out of area in 1981. Acoustic harassment device and firecrackers used by State agents in 1983/84 to deter sea lions. One to three sea lions observed almost every week in 1983/84.

1984/85
First documentation of the adverse effects of sea lion predation on steelhead escapement. One large sea lion ("Herschel") observed on a daily basis at the entrance to the fish ladder. Frequent public reports of large numbers of steelhead being eaten by sea lions. Intermittent use of firecrackers by State agents.

1985/86
Initiation of interagency monitoring and predation control program using underwater firecrackers. Number of sea lions foraging daily at the Locks increased from four to six.

1986/87
Harassment using firecrackers continues, but effectiveness in deterring sea lions declines drastically. Capture of sea lions in an entangling net was attempted unsuccessfully. Taste aversion conditioning using lithium chloride was attempted, however treated animals continued to exhibit predatory behavior delaying fish passage. Intensified harassment efforts implemented in late season involved long distance vessel chases, boat hazing, increased use of firecrackers and use of the AHD. Experimentation on use of killer whale vocalizations conducted. Number of sea lions increased to 8-10 at the Locks, 10-15 in Shilshole Bay and some animals were reported in Lake Washington.

1987/88
Barrier net installed in the spillway near fish ladder to prevent sea lion access to principal predation areas. Continuation of monitoring/harassment program. Additional harassment techniques were tested using firecrackers in combination with boat hazing. Number of sea lions increased to 10-12 foraging daily at the Locks and 20-30 in Shilshole Bay. Sea lion predation was not reduced by the barrier net, rather the predation shifted further downstream. Several sea lions observed preying on steelhead in Lake Washington; one animal remained above the dam through the summer and preyed on sockeye salmon as they exited the fish ladder.

1988/89
Capture and relocation of 39 California sea lions to the outer coast of Washington (Long Beach peninsula). 29 of these returned to Puget Sound in an average of 15 days (ranged from 4 days to 45 days). 12 sea lions were recaptured more than once (9 twice, 1 three times and 2 four times) resulting in a total of 54 relocations. 10-12 sea lions foraged daily at the Locks through the season and the number in Shilshole Bay increased to 30-40. Sport and tribal fisheries on all steelhead in the Lake Washington system were closed to eliminate all takes of wild winter-run steelhead. Nonetheless, sea lion predation exceeds 65% of total run.

1989/90
Capture and relocation of six sea lions back to their breeding area off of southern California (Channel Islands). Attempts to capture more animals unsuccessful because animals did not utilize the haul-out trap. Three of the six animals returned to Puget Sound; one in 30 days and the other two in approximately 45 days from their release. A fourth animal returned as far as southern Washington (Columbia River). Tactile harassment program using rubber tipped arrows to deter animals was attempted. An interagency technical committee on structural changes to the Locks facility was convened, but did not arrive at any structural modifications; only made recommendations on fish passage studies and recommended modified water spill patterns over the dam. The recommended altered spill protocol was implemented.

1990/91, 1991/92
No predator control program as interagency emphasis shifted to fish enhancement efforts. Monitoring occurred only in the 1990/91 season. Amended spill protocol continued. Salinity of fishway attraction water and ambient salinity below the dam was monitored. Experimentation with illumination of the fishway to enhance nighttime fish passage was attempted and salinity data collection commenced. Test results on illumination were inconclusive and confounded by technical problems and low numbers of returning fish.

1992/93
Acoustic barrier for keeping sea lions away from fishway was tested intermittently. No consistent monitoring. A conclusion on the effectiveness of the acoustic devices was complicated by observations by AIRMAR (the manufacturer of the devices) that the devices may not have been operating at maximum efficiency because of algal and barnacle growth found on transducers. Spawning escapement drops to an all-time low of 184 fish.

1993/94
Predation monitoring reinitiated. Phased non-lethal deterrence/removal program initiated with use of acoustic barrier, firecrackers, and capture and relocation. Three sea lions relocated late in season back to Channel Islands. Spawning escapement drops to all-time low of only 70 steelhead.

1994/95
MMPA amended to allow for consideration of lethal removal of sea lions at the Locks. Predation control under Section 120 of MMPA implemented allowing for lethal removal of sea lions under certain conditions. Predation monitoring underway in concert with use of acoustic barrier. Temporary captive holding attempted only with sea lion #17; other predatory sea lions could not be captured during steelhead run.

1995/1996
Pinniped task force waives captive holding requirement and authorizes lethal removal of sea lions #17, #41, #45, #87 and #225. In May, NMFS and SeaWorld negotiate permanent holding of these animals. Only sea lions #17, #45 and #225 could be captured and are shipped via FedEx to SeaWorld in Orlando. Sea lions #41 and #87 disappear during tribal fishery in Shilshole Bay. Lake Washington winter steelhead run has reached critically low levels and does not recover.

Appendix 2. Summary of food habit studies for California sea lions in Oregon and Washington and in the Columbia River. Prey species indicated occurred in more than 10% of samples.

Source:	Beach *et al*. 1985	Brown *et al*. 1995	Riemer & Brown 1997	NMML, unpublished
Location:	Columbia River Estuary	Columbia River Estuary	Cascade Head, OR	Washington marine waters
Time period:	Year-round 1980-82	Winter 1991-1993	February 1994	Year-round 1993-2003
Type:	GI tracts	GI tracts	Scat	Scat
Sample size:	16	18	82	2,245
Percent frequency of occurrence of prey (number of samples with prey/sample size*100)				
Eulachon	44	61		
Northern anchovy	19		13	
Pacific lamprey	19	17	22	
Pacific herring	13	17	24	26
Pacific tomcod	13			
Sand sole	13			
Salmon sp.	**13**	**28**	**29**	**30**
Rockfish sp.		22	21	
Sand lance		11	13	
Pacific mackerel			52	
Smelt sp.			34	
Pacific sardine			29	
Cephalopod sp.			27	
Dogfish			22	38
Skate sp.			16	
Pacific hake			15	81
Clupeid sp.				11
Pollock				10

Appendix 3. Duration and trip frequency of individually marked sea lions observed feeding on salmonids below Bonneville Dam.

		No. of days seen at dam (no. of trips from Astoria)				
Animal ID	Date tagged	2002	2003	2004	2005	2006
C147	4/1/2000		7 (2)	17 (4)	15 (3)	3 (1)
C192	3/12/2001		8 (1)	6 (2)	17 (2)	15 (1)
C193	3/12/2001			11 (3)	1 (1)	
C225	5/4/2001	1 (1)	16 (3)			
C226	5/4/2001		3 (1)			
C235	5/18/2001			1 (1)	10 (2)	
C236	5/18/2001	2 (1)	15 (4)	2 (1)	2 (1)	
C247	2/22/2002		10 (2)	23 (5)	18 (1)	19 (2)
C248	2/22/2002			15 (2)		
C251	3/1/2002		8 (3)	2 (2)		
C256	3/15/2002			5 (2)		
C257	3/15/2002	4 (1)	4 (1)	2 (1)		1 (1)
C258	3/15/2002	1 (1)	20 (3)	18 (1)	16 (2)	
C259	3/15/2002		2 (1)	6 (1)	10 (2)	
C265	4/5/2002	3 (2)	17 (3)	18 (3)	40 (2)	15 (3)
C275	4/23/2002		5 (1)	17 (2)	12 (2)	
C287	5/8/2002				6 (2)	17 (1)
C301	8/26/2002		15 (5)	23 (3)	16 (1)	
C304	8/26/2002			3 (1)		
C309	8/29/2002		19 (4)	22 (4)	18 (3)	44 (1)
C311	9/3/2002		2 (2)	5 (3)	15 (2)	
C319	9/18/2002		16 (4)	14 (3)	17 (2)	43 (2)
C322	9/23/2002		10 (2)	28 (3)	17 (3)	44 (2)
C327	9/23/2002		6 (2)	12 (2)		
C334	9/30/2002		9 (2)	23 (3)	17 (2)	
C335	10/3/2002			1 (1)		3 (1)
C360	12/10/2002					8 (1)
C361	12/16/2002		1 (1)		2 (2)	
C364	12/19/2002			8 (1)		
C379	1/31/2003				13 (2)	31 (1)
C390	2/10/2003				9 (2)	37 (1)

C396	2/27/2002	3 (1)			
C398	2/27/2002	4 (2)	13 (3)	18 (3)	
C404	3/11/2003	20 (3)	13 (2)	31 (1)	59 (1)
C417	3/27/2003		9 (1)	12 (2)	14 (1)
C426	3/31/2003	6 (1)	3 (1)	7 (2)	
C440	4/16/2003		11 (1)	15 (2)	44 (2)
C441	4/18/2003	3 (1)		1 (1)	2 (1)
C442	4/18/2003	8 (2)	17 (2)		
C443	4/18/2003		31 (4)	13 (2)	37 (1)
C444	4/25/2003	3 (1)	19 (2)	8 (3)	17 (1)
C445	4/25/2003	2 (1)			
C449	4/25/2003	1 (1)	8 (1)		1 (1)
C455	5/1/2003			18 (2)	7 (2)
C494	2/17/2004		24 (5)		
C507	3/31/2004		11 (3)	17 (3)	44 (1)
C554	9/6/2005				24 (1)
B818		2 (1)	1 (1)		1 (1)
SMI 3341			3 (2)	4 (1)	18 (1)
SMI 3696		1 (1)			
SMI 4140			11 (2)	20 (2)	

Appendix 4a. Summary of recent year average abundance compared to minimum abundance thresholds as developed by NOAAs upper Columbia Technical Review Team for the Upper Columbia spring Chinook and Snake River spring/summer Chinook ESUs.

Population	Recent 10 yr avg	Min. Abundance Threshold
UPPER COLUMBIA SPRING CHINOOK ESU		
Wenatchee River	226	2000
Entiat River	63	500
Methow River	205	2000
Okanogan River	Extirpated	NA
SNAKE RIVER SPRING/SUMMER CHINOOK ESU		
Lower Snake River		
Tucannon River	177	750
Asotin	Functionally Extirpated	500
Grande Ronde/Imnaha River		
Upper Grande Ronde	40	1000
Lostine/Wallowa River	266	1000
Catherine Creek	80	750
Minam River	337	750
Wenaha River	376	750
Lookinglass Creek	Extirpated	500
Imnaha River	395	750
Big Sheep	NA	500
South Fork Salmon River		
South Fork Mainstem	556	1000
Secesh	304	750
EF/Johnson Creek	321	1000
Little Salmon River	Insufficient Data	500
Middle Fork Salmon River		
Big Creek	94	1000
Bear Valley	188	750
Upper Mainstem MF	Insufficient Data	750
Chamberlain	Insufficient Data	500
Camas Creek	29	500
Loon Creek	51	500

Marsh Creek	42	500
Lower Mainstem MF	Insufficient Data	500
Sulphur Creek	21	500
Upper Salmon River		
Lemhi	80	2000
Lower Mainstem	123	2000
Pahsimeroi River	112	1000
East Fork Salmon River	169	1000
Upper Salmon Main	268	1000
Panther Creek (ext)	Functionally Extirpated	750
Valley Creek	35	500
Yankee Fork	13	500
NF Salmon River	Insufficient Data	500

Appendix 4b. Summary of recent year abundance in comparison with abundance goals for recovery as developed in the Lower Columbia River Salmon Recovery Plan for the lower Columbia spring Chinook and Lower Columbia winter steelhead listed populations.

Population	Recent Year Average	Recovery Goal
LOWER COLUMBIA CHINOOK ESU		
Cascade Spring		
Upper Cowlitz	365	5400
Cispus	150	1800
Tilton	150	150
Toutle	150	800
Kalama	105	1400
Lewis NF	300	2200
Sandy (OR)	2649	NA
Gorge Spring		
White Salmon	0	400
Hood (OR)	0	NA
LOWER COLUMBIA STEELHEAD DPS		
Cascade Winter		
Lower Cowlitz	NA	300
Coweeman	228	800

S.F. Toutle	453	1600
N.F. Toutle	176	700
Upper Cowlitz	0	300
Cispus	0	300
Tilton	0	150
Kalama	541	650
N.F. Lewis	NA	300
E.F. Lewis	77	600
Salmon	NA	300
Washougal	421	500
Clackamas (OR)	277	NA
Sandy (OR)	589	NA
Gorge Winter		
L. Gorge (HHD)	NA	200
U. Gorge (Wind)	463	50
Hood (OR)	136	NA